planes. Lagrange multipliers and the Karush–Kuhn–Tucker theorem for mixed constraints. Quadratic programming.

Daniel E. Cohen, Computability and Logic (Ellis Horword, Chichester; Halsted Press, New York; Wiley, New York, 1987) 243 pages

PART I: COMPUTABILITY. 1: *Epimenides, Gödel, Russell, and Cantor.* Epimenides. Gödel. Russell. Cantor. 2: *Informal Theory of Computable Functions.* Functions. Strings. Computable functions, listable sets and decidable sets. Universal functions and undecidable sets. Rice's theorem. 3: *Primitive Recursive Functions.* Primitive recursion. Bounded quantifiers and minimisation. Examples using bounded minimisation. Extensions of primitive recursion. Functions of one variable. Some functions which are not primitive recursive. Justifying definitions by primitive recursion. 4: *Partial Recursive functions.* Recursive and partial recursive functions. Recursive and recursively enumerable sets. 5: *Abacus Machines.* Abacus machines. Computing by abacus machines. Partial recursive functions. Register programs. 6: *Turing Machines.* Turing machines. Computing by Turing machines. 7: *Modular Machines.* Turing machines. Modular machines. Partial recursive functions and modular machines. Kleene's Normal Form Theorem. 8: *Church's Thesis and Gödel Numberings.* Church's Thesis. Gödel numberings. 9: *Hilbert's Tenth Problem.* Diophantine sets and functions. Coding computations. Removal of the relation $\leqslant$. Exponentiation. Gödel's sequencing function and min-computable functions. Universal diophantine predicates and Kleene's Normal Form Theorem. The four squares theorem. 10: *Indexings and the Recursion Theorem.* Pairings. Indexings. The recursion theorem and its applications. Indexings of r.e. sets. The diophantine indexing. PART II: LOGIC. 11: *Propositional Logic.* Background. The language of propositional logic. Truth. Proof. Soundness. Adequacy. Equivalence. Substitution. 12: *Predicate Logic.* Languages of first-order predicate logic. Truth. Proof. Soundness. Adequacy. Equality. Compactness and the Lowenheim-Skolem theorems. Equivalence. 13: *Undecidability and Incompleteness.* Some decidable theories. Expressible sets and representable functions. The main theorems. Further results. 14: *The Natural Numbers under Addition.* The order relation on Q. The natural numbers under addition.

M.J.B. Duff and T.J. Fountain, eds., Cellular Logic Image Processing (Academic Press, Harcourt Brace Jovanovich, London, 1986) 277 pages

Introduction (M.J.B. Duff). *Chapter* 1: *Basic CLIP Processing* (S.D. Pass). *Chapter* 2: *Propagation in Cellular Arrays* (G.P. Otto). *Chapter* 3: *Software for CLIP* 4 (A.M. Wood and D.E. Reynolds). *Chapter* 4: *Serial Section Reconstruction* (H.H.-S. Ip). *Chapter* 5: *Colony Counting and Analysis* (D.J. Potter). *Chapter* 6: *Computer Tomography* (K.A. Clarke). *Chapter* 7: *Motion Analysis* (A.M. Wood). *Chapter* 8: *Automatic Segmentation* (D.E. Reynolds). *Chapter* 9: *Further Developments* (T.J. Fountain).

Martin Grotschel, Laszlo Lovasz and Alexander Schrijver, Geometric Algorithms and Combinatorial Optimization (Springer, Berlin, 1988) 362 pages

Chapter 0: *Mathematical Preliminaries.* Linear algebra and linear programming (Basic notation. Hulls, independence, dimension. Eigenvalues, positive definite matrices. Vector norms, balls. Matrix norms. Some inequalities. Polyhedra, inequality systems. Linear (diophantine) equations and inequalities. Linear programming and duality). Graph theory (Graphs. Digraphs. Walks, paths, circuits, trees). *Chapter* 1: *Complexity, Oracles, and Numerical Computation.* Complexity theory: $\mathscr{P}$ and $\mathscr{NP}$ (Problems. Algorithms and Turing machines. Encoding. Time and space complexity). Oracles (The running time of oracle algorithms. Transformation and reduction. $\mathcal{NP}$-completeness and related notions). Approximation and computation of numbers (Encoding length of numbers. Polynomial and strongly polynomial computations. Polynomial time approximation of real numbers). Pivoting and related procedures (Gaussian elimination. Gram–Schmidt orthogonalization. The simplex method. Computation of the hermite normal form). *Chapter* 2: *Algorithmic Aspects of Convex Sets: Formulation of the Problems.* Basic algorithmic problems for convex sets. Nondeterministic decision problems for convex sets. *Chapter* 3: *The Ellipsoid Method.* Geometric background and an informal description (Properties of ellipsoids. Description of the basic ellipsoid method. Proofs of some lemmas. Implementation problems and polynomiality. Some examples). The central-cut ellipsoid method. The shallow-cut ellipsoid method. *Chapter* 4: *Algorithms for Convex Bodies.* Summary of results. Optimization from separation. Optimization from membership. Equivalence of the basic problems. Some negative results. Further algorithmic problems for convex bodies. Operations on convex bodies (The sum. The convex hull of the union. The intersection. Polars, blockers, antiblockers). *Chapter* 5: *Diophantine Approximation and Basis Reduction.* Continued fractions. Simultaneous diophantine approximation: Formulation of problems. Basis reduction in lattices. More on lattice algorithms. *Chapter* 6: *Rational Polyhedra.* Optimization over polyhedra: A preview. Complexity of rational polyhedra. Weak and strong problems. Equivalence of strong optimization and separation. Further problems for polyhedra. Strongly polynomial algorithms. Integer programming in bounded dimension. *Chapter* 7: *Combinatorial Optimization: Some Basic Examples.* Flows and cuts. Arborescences. Matching. Edge coloring. Matroids. Subset sums. Concluding remarks. *Chapter* 8: *Combinatorial Optimization: A Tour d'Horizon.* Blocking hypergraphs and polyhedra. Problems on bipartite graphs. Flows, paths, chains, and cuts. Trees, branchings, and rooted and directed cuts (Arborescences and rooted cuts. Trees and cuts in undirected graphs. Dicuts and dijoins). Matchings, odd cuts, and generalizations (Matching. b-matching. T-joins and T-cuts. Chinese postmen and traveling salesmen). Multicommodity flows. *Chapter* 9: *Stable Sets in Graphs.* Odd circuit constraints and t-perfect graphs. Clique constraints and perfect graphs (Antiblockers of hypergraphs). Orthonormal representations. Coloring perfect graphs. More algorithmic results on stable sets. *Chapter* 10: *Submodular Functions.* Submodular functions and polymatroids. Algorithms for polymatroids and submodular functions (Packing bases of a matroid). Submodular functions on lattice, intersecting, and crossing families. Odd submodular function minimization and extensions.

Gregory Karpilovsky, Field Theory: Classical Foundations and Multiplicative Groups (Marcel Dekker, New York, 1988) 551 pages

Chapter 1: *Preliminaries.* Notation and terminology. Polynomial algebras. Integral extensions. Tensor products. Module-theoretic prerequisites. Topological prerequisites. *Chapter* 2: *Classical Topics in Field Theory.* Algebraic extensions. Normal extensions. Separable, purely inseparable and simple extensions. Galois extensions. Finite fields, roots of unity and cyclotomic extensions. Norms, traces and their applications. Discriminants and integral bases. Units in quadratic fields. Units in pure cubic fields. Finite Galois theory. Profinite groups. Infinite Galois theory. Witt vectors. Cyclic extensions. Kummer theory. Radical extensions and related results. Degrees of sums in a separable field extension. Galois cohomology. The Brauer group of a field. An interpretation of $H_0^3(G,E^*)$. A cogalois theory for radical extensions. Abelian p-extensions over fields of characteristic p. Formally real fields. Transcendental extensions. *Chapter* 3: *Valuation Theory.* Valuations. Valuation rings and places. Dedekind domains. Completion of a field. Extensions of valuations. Valuations of algebraic number fields. Ramification index and residue degree. Structure of complete discrete valued fields (Notation and terminology. The equal characteristic case. The unequal characteristic case. The inertia field. Cyclotomic extensions of p-adic fields). *Chapter* 4: *Multiplicative Groups of Fields.* Some general observations. Infinite abelian groups. The Dirichlet–Chevalley- Hasse Unit Theorem. The torsion subgroup. Global fields. Algebraic-